

**WHAT IS CLAIMED IS:**

1. A multi-wavelength light source comprising:

a substrate;

a laser laminated on a first portion of the substrate wherein said laser adapted for  
5 generating multi-wavelength light including a plurality of peaks whose wavelengths and  
spacing are identical to these of WDM channels when driven by a driving current below a  
predetermined threshold current; and

a semiconductor optical amplifier means for reducing noise being laminated on a  
second portion of the substrate, said semiconductor optical amplifier being arranged on the  
10 second portion of the substrate so as to amplify an output from the fabry-perot laser by  
having a first end surface comprising a slanted surface of the semiconductor optical  
amplifier that is opposed to a side surface of the laser,

wherein the semiconductor optical amplifier means is adapted to reduce a relative  
intensity of noise in the plurality of channels of the multi-wavelength light and  
15 simultaneously amplifying the multi-wavelength light by being driven in a gain saturation  
state .

2. The multi-wavelength light source as claimed in claim 1, wherein the laser  
comprises a fabry-perot laser, and the multi-wavelength light source further comprises:

20 a high reflection layer coated on a first end surface of the multi-wavelength light  
source, the first end surface of the multi-wavelength light source including a first end  
surface of the fabry-perot laser; and

anti-reflection layers being arranged on a side surface of the fabry-perot laser, the slanted surface of the semiconductor optical amplifier, and a second end surface of the multi-wavelength light source,

wherein the second end surface of the multi-wavelength light source includes a  
5 second end surface of the semiconductor optical amplifier means, and

wherein the side surface of the laser and the slanted surface of the semiconductor optical amplifier are opposed to each other.

3. The multi-wavelength light source as claimed in claim 1, wherein a band gap of  
10 the semiconductor optical amplifier means is smaller than that of the fabry-perot laser, so that a spectrum of the multi-wavelength light outputted from the fabry-perot laser coincides with a gain spectrum that is amplified by the semiconductor optical amplifier.

4. The multi-wavelength light source as claimed in claim 1, wherein the slanted  
15 surface of the semiconductor optical amplifier means opposed to the fabry-perot laser is inclined at a predetermined angle with respect to the side surface of the fabry-perot laser.

5. A multi-wavelength light source comprising:

a fabry-perot laser adapted for generating multi-wavelength light including a  
20 plurality of peaks having different wavelengths when driven by driving a current below a predetermined threshold current; and

a semiconductor optical amplifier means for reducing noise being connected to an

output of the fabry-perot laser for amplifying the multi-wavelength light outputted from the fabry-perot laser,

wherein the semiconductor optical amplifier means is driven in a gain saturation state to reduce a relative intensity of noise in the plurality of channels of the multi-wavelength light and for simultaneously amplifying the multi-wavelength light.

6. The multi-wavelength light source as claimed in claim 5, wherein a band gap of the semiconductor optical amplifier is smaller than that of the fabry-perot laser, so that a spectrum of the multi-wavelength light output from the fabry-perot laser coincides with a gain that is amplified by the semiconductor optical amplifier.

7. A wavelength division multiplexing system comprising a central office, a remote node connected to the central office by an optical fiber, and a plurality of subscribers connected to the remote node, wherein the central office including:

15 a light source section including a laser and a semiconductor optical amplifier, the laser driven by driving current below threshold current so as to generate multi-wavelength light including a plurality of downstream channels having different wavelengths, and

the semiconductor optical amplifier for amplifying the multi-wavelength light in a gain saturation state so as to output the amplified multi-wavelength light;

20 a demultiplexer for demultiplexing the multi-wavelength light into a plurality of downstream channels having different wavelengths so as to output the demultiplexed downstream channels;

a first multiplexer/demultiplexer for demultiplexing an upstream optical signal outputted from the remote node into a plurality of upstream channels having different wavelengths, and multiplexing the downstream channels into a downstream optical signal so as to output the multiplexed optical signal to the remote node; and

5 a plurality of photodetectors for detecting the upstream channels demultiplexed by the first multiplexer/demultiplexer.

8. The multi-wavelength light source as claimed in claim 7, wherein the laser of the light source section includes a fabry-perot laser.

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9. The multi-wavelength light source as claimed in claim 7, wherein the central office further comprises:

a plurality of modulators for modulating the downstream channels demodulated by the demultiplexer; and

15 a plurality of wavelength selection couplers located between each of the modulators and the first multiplexer/demultiplexer, for outputting the downstream channels that are output from the modulators to the first multiplexer/demultiplexer, and for outputting the upstream channels, which are outputted from the first multiplexer/demultiplexer, to a corresponding photodetector.

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10. The multi-wavelength light source as claimed in claim 7, wherein the remote node includes a second multiplexer/demultiplexer for multiplexing a plurality of upstream channels having different wavelengths, which are output from the subscribers, into an upstream optical signal so as to output the multiplexed optical signal to the central office,  
5 and demultiplexing the downstream optical signal output from the central office into a plurality of downstream channels so as to output the demultiplexed downstream channels to a corresponding subscriber.

11. The multi-wavelength light source as claimed in claim 7, wherein each  
10 subscriber comprises:  
a photodetector for detecting a corresponding downstream channel;  
a light source for outputting the upstream channel to the remote node; and  
a wavelength selection coupler for outputting the downstream channel to the photodetector, and outputting the upstream channel generated by the light source to the  
15 remote node.

12. A wavelength division multiplexing system comprising a central office that generates a downstream optical signal, a remote node that demultiplexes the downstream optical signal into a plurality of upstream channels having different wavelengths, and a  
20 plurality of subscribers connected to the remote node, wherein the central office includes:  
a plurality of light sources for generating mode-locked downstream channels having different wavelengths by incoherent lights;

a plurality of photodetectors for detecting a plurality of upstream channels;

a downstream broadband light source that includes a first laser, a first semiconductor optical amplifier, and a first isolator, the first laser driven by driving current below threshold current so as to generate downstream light, which includes a plurality of  
 5 incoherent lights having different wavelengths, for mode-locking the light sources, the first semiconductor optical amplifier amplifying the downstream light in a gain saturation state so as to output the amplified downstream light, the first isolator reflecting an upstream optical signal outputted from the remote node, and passing the downstream light amplified by the first semiconductor optical amplifier;

10 an upstream broadband light source includes a second laser, a second semiconductor optical amplifier, and a second isolator, the second laser driven by driving current below threshold current so as to generate upstream light, which includes a plurality of incoherent lights, for mode-locking the subscribers, the second semiconductor optical amplifier amplifying the upstream light in a gain saturation state so as to output the  
 15 amplified downstream light, the second isolator reflecting the downstream optical signal and passing the upstream light; and

a first multiplexer/demultiplexer for demultiplexing the downstream light into a plurality of incoherent lights so as to output the demultiplexed incoherent lights to a corresponding light source, multiplexing the downstream channels generated by the light  
 20 sources into a downstream optical signal so as to output the multiplexed optical signal, and demultiplexing the upstream optical signal into upstream channels having different wavelengths so as to output the demultiplexed upstream channels to a corresponding

photodetector.

13. The multi-wavelength light source as claimed in claim 12, wherein the central office comprises:

- 5           wavelength selection couplers for outputting the incoherent lights, which are outputted from the first multiplexer/demultiplexer, to a corresponding light source, outputting the upstream channels to a corresponding photodetector, and outputting the downstream channels generated by the light sources to the first multiplexer/demultiplexer; and
- 10           an optical coupler for outputting the downstream light and the upstream optical signal to the first multiplexer/demultiplexer, and outputting the upstream light and the downstream optical signal to the remote node.

14. The multi-wavelength light source as claimed in claim 12, wherein the remote
- 15   node includes a second multiplexer/demultiplexer for demultiplexing the downstream optical signal outputted from the optical coupler into downstream channels having different wavelengths so as to output the demultiplexed downstream channels to a corresponding subscriber, multiplexing a plurality of upstream channels having different wavelengths generated by the subscribers into an upstream optical signal so as to output the multiplexed
- 20   optical signal to the central office, and demultiplexing the upstream light outputted from the central office into a plurality of incoherent lights having different wavelengths so as to output the demultiplexed incoherent light to the subscribers.

15. The multi-wavelength light source as claimed in claim 12, wherein each subscriber comprises:

a light source for generating a mode-locked upstream channel by corresponding incoherent light;

5 a photodetector for detecting a corresponding downstream channel; and

a wavelength selection coupler for outputting the downstream channel, which is outputted from the remote node, to the photodetector, outputting the incoherent light to the light source, and outputting the mode-locked upstream channel generated by the light source to the remote node.

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16. A method for multi-wavelength light amplification with relatively reduced channel noise, said method comprising the steps of:

(a) generating multi-wavelength light including a plurality of channels having different wavelengths when driven by driving a current below a predetermined threshold

15 current; and

(b) amplifying the multi-wavelength light output from the laser by a semiconductor optical amplifier operating in the gain saturation state so as to reduce a relative noise in the plurality of channels,

wherein the semiconductor optical amplifier means is driven in a gain saturation  
20 state to reduce a relative intensity of noise in the plurality of channels of the multi-wavelength light and for simultaneously amplifying the multi-wavelength light.



17. The method according to claim 16, wherein the laser used in step (a) comprises a fabry-perot laser adapted for generating multi-wavelength light.

18. A method of manufacturing a multi-wavelength light source device,  
5 comprising the steps of:

(a) providing a substrate;

(b) arranging a laser on a first portion of the substrate wherein said laser adapted for generating multi-wavelength light including a plurality of channels having different wavelengths when driven by a driving current below a predetermined threshold current; and

10 (c) arranging a semiconductor optical amplifier means for reducing noise on a second portion of the substrate, said semiconductor optical amplifier being arranged on the second portion of the substrate so as to amplify an output from the laser arranged on the first portion of the substrate by having a first end surface of the semiconductor optical amplifier comprising a slanted surface that is arranged to oppose a side surface of the laser;

15 and

(d) driving the semiconductor optical amplifier in a gain saturation states so as to reduce a relative intensity of noise in the plurality of channels of the multi-wavelength light and for simultaneously amplifying the multi-wavelength light.

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19. The method according to claim 18, wherein the laser comprises a fabry-perot laser, and the multi-wavelength light source is manufactured according to the additional steps:

(e) providing a high reflection layer coating on a first end surface of the multi-wavelength light source, the first end surface of the multi-wavelength light source including a first end surface of the fabry-perot laser; and

(f) arranging anti-reflection layers on a side surface of the fabry-perot laser, the slanted surface of the semiconductor optical amplifier, and a second end surface of the multi-wavelength light source.

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20. The method according to 19, wherein the slanted surface of the semiconductor optical amplifier means opposed to the fabry-perot laser is inclined at a predetermined angle with respect to the side surface of the fabry-perot laser.